~~January 2002~~ December 2002

HARBOR SEAL (*Phoca vitulina*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas above about 30^0N (Katona *et al*. 1993). In the western North Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona *et al*. 1993; Gilbert and Guldager 1998; Baird 2001). Stanley *et al*. (1996) examined worldwide patterns in harbor seal mitochondrial DNA, which indicate that western and eastern North Atlantic harbor seal populations are highly differentiated. Further, they suggested that harbor seal females are only regionally philopatric, thus population or management units are on the scale of a few hundred kilometers. Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern USA and Canadian coasts represent one population (Temte *et al*. 1991). In USA waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al*. 1991; Katona *et al*. 1993).

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona *et al*. 1993), and occur seasonally along the southern New England and New York coasts from September through late May (Schneider and Payne 1983). In recent years, their seasonal interval along the southern New England to New Jersey coasts has increased (Barlas 1999; Hoover *et al*. 1999; Slocum *et al*. 1999; deHart 2002). Scattered sightings and strandings have been recorded as far south as Florida (NMFS unpublished data). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld *et al*. 1988; Whitman and Payne 1990; Barlas 1999; Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). No pupping areas have been identified in southern New England (Payne and Schneider 1984; Barlas 1999). More recent information suggests that pupping is occurring at high-use haulout sites off Manomet, Massachusetts (B. Rubinstein, pers. comm., New England Aquarium). The overall geographic range throughout coastal New England has not changed significantly during the last century (Payne and Selzer 1989).

Prior to spring 2001 live capture and radio tagging of adult harbor seals, including a pregnant female, in Chatham, Massachusetts (NMFS unpub. data), it was believed that the majority of seals moving into southern New England and mid-Atlantic waters are subadults and juveniles (Whitman and Payne 1990; Katona *et al*. 1993; Slocum *et al*. 1999). ~~Whitman and Payne (1990) suggest that the age-related dispersal may reflect the higher energy requirements of younger animals.~~

POPULATION SIZE

Since passage of the MMPA in 1972, the ~~number~~observed count of seals along the New England coast has increased nearly ~~five-fold~~nine-fold. ~~Coast-wide~~Six coast-wide aerial surveys along the Maine coast have been conducted in May/June during pupping. ~~in 1981, 1982, 1986, 1993, and 1997 (Table 1; Gilbert and Stein 1981; Gilbert and Wynne 1983, 1984; Kenney 1994; and Gilbert and Guldager 1998)~~. Annual counts, with number of pups in parentheses, between 1981 to 2001 were 10,540 (676) in 1981, 9,331 (1,198) in 1982, 12,940 (1,713) in 1986, 28,810 (4,250) in 1993, 30,990 (5,359) in 1997, and 99,340 (23,723) in 2001 (Table1; Gilbert and Stein 1981; Gilbert and Wynne 1983, 1984; Kenney 1994; Gilbert and Guldager 1998; J. Gilbert, pers. comm.). As recommended in the GAMMS Workshop Report (Wade and Anglis 1997), estimates older than eight years and are deemed unreliable, therefore should not be used for PBR determinations. ~~The following~~Prior to 2001, the numbers are considered to be a minimum abundance estimate because they are uncorrected for animals in the water or outside the survey area. A coast-wide survey, which included replicate surveys and radio tagged seals to obtain a correction factor for animals not hauled out, was conducted in May/June 2001. ~~Data are presently under analysis~~The 2001 observed count of 38,011 was 22.7% greater than the 1997 count. Increased abundance of seals in the northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites ~~in between~~ from the

Maine/New Hampshire border to eastern Long Island and New Jersey (Payne and Selzer 1989; Rough 1995; Barlas 1999; Hoover *et al*. 1999; Slocum *et al*. 1999; deHart 2002).

Canadian scientists counted 3,500 harbor seals during an August 1992 aerial survey in the Bay of Fundy (Stobo and Fowler 1994), but noted that the survey was not designed to obtain a population estimate. The Sable Island population was the largest in eastern Canada in the late 1980's, however, recently the number has drastically declined (Baird 2001). Similarly, pup production declined from 600 in 1989 to 30 in 1997 (Baird 2001).

Table 1. Summary of abundance estimates for the western Atlantic harbor seal. Month, year, and area covered during each abundance survey, resulting abundance estimate ~~(N_{min})~~ (N_{best}) and coefficient of variation (CV).

Month/Year	Area	~~N_{min}~~ N_{best}[1]	CV
May/June 1997	Maine coast	30,990 (5,359)	None reported
May/June 2001	Maine coast	99,340 (21,732)[2]	CV = .097

[1] Pup counts are in brackets

[2] Uncorrected count of 38,011 (8,814)

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor seals is 99,340 (CV = .097). The minimum population estimate is ~~30,990~~ 91,546 (CV = .097) based on ~~uncorrected~~ corrected total counts along the Maine coast in ~~1997~~ 2001.

Current Population Trend

The average increase in uncorrected counts over the 1981-~~1997~~2001 survey period (e.g., 1981, 1982, 1986, 1993, ~~and~~ 1997, and 2001) has been ~~4.2% (Gilbert and Guldager 1998), about 50% of the 8.9 percent annual increase estimated by Kenney (1994) from counts through 1993~~. 6.6 % (J. Gilbert, pers. comm.). ~~This suggests that population increase may have slowed. Similarly, the number of pups along the Maine coast has increased at an annual rate of 12.9% over the 1981-1997 period (Gilbert and Guldager 1998).~~The 1981 survey was in early June and the 1986 survey was in mid- to late June; therefore, peak pupping period was likely missed in both years. Possible factors contributing to harbor seal population increase include MMPA protection, fishery management regulations (e.g., closed areas, fishing effort reduction) designed to rebuild groundfish stocks, and habitat protection of important haulout sites (e.g., National Park Service and National Wildlife Refuge lands).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this population. Based on uncorrected haulout counts over the 1981 to 2001 survey period, the harbor seal population was approximately 6.6 % (J. Gilbert, pers. comm.). However, a population grows at the maximum growth rate (R_{MAX}) only when it is at a very low level; thus the 6.6% growth rate is not considered to be a reliable estimate of (R_{MAX}). ~~Current and maximum net productivity rates are unknown for this stock.~~ For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate (½ of 12%), and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~30,990~~91,546. The ~~maximum productivity rate~~ recovery factor (F_R) for this stock is ~~0.12~~1.0, the ~~default~~ value for ~~pinnipeds~~ stocks of unknown status, but known to be increasing. ~~The recovery factor~~

~~(F_R) for this stock is 1.0, the value for stocks of unknown status, but is known to be increasing.~~ PBR for USA waters is ~~1,859~~5,493.

ANNUAL HUMAN-CAUSED MORTALITY

For the period ~~1996-2000~~1997-2001, the total estimated human caused mortality and serious injury to harbor seals is estimated to be ~~857~~972 per year. The average is derived from two components: 1) ~~843~~955 (~~CV=0.17~~CV= 0.18; Table 2) from the ~~1995-1999~~1997-2001 observed fishery; and 2) ~~14~~17 from average ~~1997-2000~~1997-2001 stranding mortalities resulting from boat strikes, power plant entrainments, shooting, and other sources.

Researchers and fishery observers have documented incidental mortality in several fisheries, particularly within the Gulf of Maine (see below). An unknown level of mortality also occurred in the mariculture industry (*i.e.*, salmon farming), and by deliberate shooting (NMFS unpublished data). However, no data are available to determine whether shooting still takes place.

Fishery Information

USA

Historical: Incidental takes of harbor seals have been recorded in groundfish gillnet, herring purse seine, halibut tub trawl, and lobster fisheries (Gilbert and Wynne, 1985 and 1987). A study conducted by the University of Maine reported a combined average of 22 seals entangled annually by 17 groundfish gillnetters off the coast of Maine (Gilbert and Wynne 1987). All seals were young of the year and were caught from late June through August and in early October. Interviews with a limited number of mackerel gillnetters indicated only one harbor seal entanglement and a negligible loss of fish to seals. Net damage and fish robbing were not reported to be a major economic concern to gillnetters interviewed (Gilbert and Wynne 1987).

Herring purse seiners have reported accidentally entrapping seals off the mid-coast of Maine, but indicated that the seals were rarely drowned before the seine was emptied (Gilbert and Wynne 1985). Capture of seals by halibut tub trawls is rare. One vessel captain indicated that he took one or two seals a year. These seals were all hooked through the skin and released alive, indicating they were snagged as they followed baited hooks. Infrequent reports suggest seals may rob bait off longlines, although this loss is considered negligible (Gilbert and Wynne 1985).

Incidental takes in lobster traps in inshore waters off Maine are reportedly rare. Captures of approximately two seal pups per port per year were recorded by mid-coastal lobstermen off Maine (Gilbert and Wynne 1985). Seals have been reported to rob bait from inshore lobster traps, especially in the spring, when fresh bait is used. These incidents may involve only a few individual animals. Lobstermen claim that seals consume shedding lobsters, but there is no data to support this.

Current: Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Northeast Multispecies Sink Gillnet:

In 1993, there were approximately 349 full and part-time vessels in the Northeast multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden 1996) and their fishing effort was not used in estimating mortality. In 1998, there were approximately 301 vessels in this fishery (NMFS unpublished data). Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6%, and ~~6%~~4% for 1990 to ~~2000~~2001, respectively. The fishery has been observed in the Gulf of Maine and in southern New England (Williams 1999). There were ~~362~~394 harbor seal mortalities observed in the Northeast multispecies sink gillnet fishery between 1990 and ~~2000~~2001, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data). Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (e.g. less than four

years old). Annual estimates of harbor seal bycatch in the Northeast multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery during 1990- ~~2000~~2001 were 602 in 1990 (0.68), 231 in 1991 (0.22), 373 in 1992 (0.23), 698 in 1993 (0.19), 1,330 in 1994 (0.25), 1,179 in 1995 (0.21), 911 in 1996 (0.27), 598 in 1997 (0.26), 332 in 1998 (0.33), 1446 in 1999 (0.34), ~~and~~ 917 (0.43) in 2000, and 1471 (.38) in 2001. The 1994 and 1995 bycatches, respectively, include 14 and 179 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of bycatch of harbor seals, gray seals, harp seals, and hooded seals. ~~Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1996-2000 was 843 harbor~~Since 1997, unidentified seals ~~(CV= 0.17)~~have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. There were 0, 1, 5, and 8 unidentified seals observed during 1998 through 2001, respectively. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1997-2001 was 953 harbor seals (CV= 0.18). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The bycatch occurred in Massachusetts Bay, south of Cape Ann and west of Stellwagen Bank during January-March. Bycatch locations became more dispersed during April-June from Casco Bay to Cape Ann, along the 30 fathom contour out to Jeffreys Ledge, with one take location near Cultivator Shoal and one off southern New England near Block Island. Incidental takes occurred from Frenchman's Bay to Massachusetts Bay during July-September. In inshore waters, the takes were aggregated while offshore takes were more dispersed. Incidental takes were confined from Cape Elizabeth out to Jeffreys Ledge and south to Nantucket Sound during October-December.

Mid-Atlantic Coastal Gillnet

Observer coverage of the USA Atlantic coastal gillnet fishery was initiated by the NEFSC Sea Sampling program in July, 1993; and from July to December 1993, 20 trips were observed. During 1994 and 1995, 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized. Observer coverage, expressed as percent of tons of fish landed, was 5%, 4%, 3%, 5%, 2%, 2%, and 2% for 1995, 1996, 1997, 1998, 1999, ~~and~~ 2000, and 2001, respectively (Table 2).

No harbor seals were taken in observed trips during 1993-1997, and ~~1999-2000~~1999-2001. Two harbor seals were observed taken in 1998 (Table 2). Observed effort was concentrated off NJ and scattered between DE and NC from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997 and ~~1999-2000~~1999-2001 and 11 in 1998 (0.77). Average annual estimated fishery-related mortality attributable to this fishery during ~~1996-2000~~1997-2001 was 2 harbor seals (CV=0.77).

CANADA

Currently, scant data are available on bycatch in Atlantic Canada fisheries due to a lack of observer programs (Baird 2001). An unknown number of harbor seals have been taken in Newfoundland, Labrador, Gulf of St. Lawrence and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting.

~~There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994).~~

~~There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.~~

~~Herring weirs are also distributed throughout the Bay of Fundy; it has been reported that 180 weirs were operating in the Bay of Fundy in 1990 (Read 1994).~~

In 1996, observers recorded 7 harbor seals (one released alive) in Spanish deep-water trawl fishing on the southern edge of the Grand Banks (NAFO Areas 3) (Lens, 1997). Seal bycatches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 2. Summary of the incidental mortality of harbor seals (*Phoca vitulina*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type[1]	Observer Coverage[2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast[3] Multispecies Sink Gillnet	97-01 ~~96-00~~	301	Obs. Data Weighout, Logbooks	~~.04~~, .06, .05, .06, .06, .04	~~36,~~ 48, 15, 49, 26, 32	~~911,~~ 598, 332, 1446, 917, 1471	~~.27,~~ .26, .33, .34, .43, .38	~~841~~ 953 ~~(0.17)~~ (0.18)
mid-Atlantic Coastal Sink Gillnet	97-01 ~~96-00~~	Unk[4]	Obs. Data Weighout	~~.04,~~ .03, .05, .02, .02, .02	~~0~~, 0, 2, 0, 0, 0	~~0,~~ 0, 11, 0, 0, 0	~~0,~~ 0, .77, 0, 0, 0	2 (.77)
TOTAL								~~843~~ 955 ~~(0.17)~~ (0.18)

[1] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.

[2] The effort for the Northeast multispecies sink gillnet fishery is measured in trips. Observer coverage of the mid-Atlantic coastal gillnet fishery is measured in tons of fish landed.

[3] In ~~1996,~~1997, 1998, 1999, ~~and~~ 2000, and 2001 respectively, observed mortality on "marine mammal trips" was ~~37, 14~~43, 13, 45, 26, and 27 animals. Only these mortalities were used to estimate total harbor seal bycatch. See Bisack (1997) for "trip" type definitions. From ~~1996~~1997 to ~~2000, 3~~2001, respectively, 1, 2, 4, 3, and ~~3~~5 harbor seals were observed on dedicated fish sampling trips. From ~~1996~~1997 to ~~2000, 2~~2001, respectively, 14, 1, 5, 8, and 10 harbor seals were observed taken in nets equipped with pingers. Since 1998, takes from non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered nets not within a marine mammal time/area closure that did not required pingers were pooled with the takes from nets with and without pingers from the same stratum. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality.

[4] Number of vessels is not known.

Other Mortality

Harbor seals were bounty hunted in New England waters until the mid-1960's, which~~. This hunt~~ may have caused the demise of this stock in USA waters (Katona *et al*. 1993).

Annually, small numbers of harbor seals regularly strand throughout their migratory range. Most reported strandings, however, occur during the winter period in southern New England and mid-Atlantic regions (NMFS unpublished data). Sources of mortality include human interactions (boat strikes and fishing gear, power plant intake (12-20 per year; NMFS unpublished data), oil, shooting ~~(around salmon aquaculture sites and fixed fishing gear)~~, storms, abandonment by the mother, and disease (Katona *et al*. 1993; Jacobs and Terhune 2000; NMFS unpublished data). Interactions with Maine salmon aquaculture operations appears to be increasing, although the magnitude of interactions and seal mortalities has not been quantified (Anon 1996). Aquaculture operations in eastern Canada are licenced to shoot nuisance seals, but issuance of personal "Fishing Licence" to hunt seals is

closed for harbour seals (Baird 2001). In 1980, more than 350 seals were found dead in the Cape Cod area from an influenza outbreak (Geraci *et al*. 1981).

Reported harbor seal strandings from1997 to 2001 were:153 in 1997, 256 in 1998, 150 in 1999, 219 in 2000, and 246 in 2001.~~The 1992-1996 harbor seal strandings data are currently under review. In 1995 one stranding was in South Carolina. Reported harbor seal strandings during 1997-2000 were: 1997 (153),1998 (256), 1999 (150), and 2000 (219).~~ Strandings were reported in all states between Maine and North Carolina, and in 1997 one each was reported in Georgia and Florida. Of1024 strandings, Maine (~~350/778~~446), Massachusetts (~~190/778~~258), New York (~~78/778~~104) and New Jersey (~~46/778~~61) accounted for most ofthe strandings, reflecting both long coastlines and habitat use. ~~Fifty five~~Eighty-six (~~7%~~8.4%) ofthe stranded animals during this ~~four~~ five year period showed signs ofhuman interactions: fishery (~~14~~24), vessel strike (~~4~~8), power plant (22), and other (~~15~~32). Further, many live strandings are euthanized due to condition ofthe animals. Some sick and injured seals are transported to rehabilitation facilities, and some human harassed (e.g., attempted feeding, petting , etc) seals are relocated.

Stranding data probably underestimate the extent offishery-related mortality and serious injury because not all ofthe marine mammals which die or are seriously injured may wash ashore, nor will all ofthose that do wash ashore necessarily show signs ofentanglement or other fishery-interaction.

Stobo and Lucas (2000) have documented shark predation as an important source ofnatural mortality at Sable Island, Nova Scotia. They suggest that shark-inflicted mortality in pups, as a proportion oftotal production, was less than 10% in 1980-1993, approximately 25% in 1994-1995, and increased to 45% in 1996. Also, shark predation on adults was selective towards mature females. They suggest that the combined predation mortality is likely impacting the Sable Island population growth, and may be contributing to the observed population decline.

STATUS OF STOCK

The status ofharbor seals, relative to OSP, in the US Atlantic EEZ is unknown, but the population is increasing. The species is not listed as threatened or endangered under the Endangered Species Act. Gilbert and Guldager (1998) estimated a 4.4% annual rate ofincrease ofthis stock in Maine coastal waters based on 1981, 1982, 1986, 1993, 1997 surveys conducted along the Maine coast. The population is increasing despite the known fishery-related and other human sources ofmortality. Total fishery-related mortality and serious injury for this stock is not less than 10% ofthe calculated PBR and, therefore, cannot be considered to be approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

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GRAY SEAL (*Halichoerus grypus*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal is found on both sides of the North Atlantic, with three major populations: eastern Canada, northwestern Europe and the Baltic Sea (Katona *et al*. 1993). The western North Atlantic population occurs from New England to Labrador and is centered in the Sable Island region of Nova Scotia (Mansfield 1966; Katona *et al*. 1993; Davies 1957; Lesage and Hammill 2001). This stock is separated by ~~both~~ geography, differences in the breeding season, and mitochondrial DNA variation from the eastern Atlantic stock (Bonner 1981; Boskovic *et al*. 1996; Lesage and Hammill 2001). ~~The western North Atlantic stock is distributed and breeds principally in eastern Canadian waters (Mansfield 1966).~~ There are two breeding concentrations in eastern Canada; one at Sable Island, and a second that breeds on the pack ice in the Gulf of St. Lawrence (Laviguer and Hammill 1993). Tagging studies indicate that there is little intermixing between the two breeding groups (Zwanenberg and Bowen 1990) and, for management purposes, they are treated as separate populations (Mohn and Bowen 1996). However, small numbers of animals and pupping have been observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona *et al*. 1993; Rough 1995; J. R. Gilbert, pers. comm., University of Maine, Orono, ME). In the late 1990's, a year-round breeding population of approximately 400+ animals was documented on outer Cape Cod and Muskeget Island (Dennis Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and at the Monomoy National Wildlife Refuge (NWR). Gilbert (pers. comm.) has also documented resident colonies and pupping in Maine since 1994.

POPULATION SIZE

Current estimates of the total western Atlantic gray seal population are not available; although four estimates of portions of the stock are available for select time periods. In 1993 an estimate of the Sable Island and Gulf of St. Lawrence stocks was 143,000 animals (Mohn and Bowen 1994). The population in waters off Maine has increased from about 30 in the early 1970's to 500-1,000 in 1993 and 1,500-1,700 in 2001 (J.R. ~~The population in waters off Maine has increased from about 30 in the early 1980's to between 500-1,000 animals in 1993~~ (J. R. Gilbert, pers. comm). Recently, 29-49 pups/year have been recorded at one pupping site in Penobscot Bay, and in the winter of 2000, approximately 150 gray seals (adults and pups) were recorded at a second pupping site (J. R. Gilbert, pers. comm.). Maximum counts of individuals obtained during the spring molt at a winter breeding colony on Muskeget Island, west of Nantucket Island, did not exceed 13 in any year during the 1970s, but rose to 61 in 1984, 192 in 1988, 503 in 1992, and 1,549 in 1993. Aerial surveys in April and May of 1994 recorded a peak count of 2,010 gray seals for Muskeget Island and Monomoy combined (Rough 1995; ~~Table 1~~). From December 1998 to July 1999 the Northeast Fisheries Science Center conducted aerial surveys in the same region surveyed by Payne and Selzer (1989) and Rough (1995). The peak gray seal count in the region between Isle of Shoals, New Hampshire and Woods Hole, Massachusetts was 5,611 (5/21/99; Table 1). No gray seals were recorded at haulout sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999), although, more recently small numbers of gray seals have been recorded in this region (deHart 2002; R. DiGiovanni, pers. comm., Riverhead Foundation, Riverhead, NY). The 1999 count is 2.8 times greater than the 1994 count. Ninety three percent of the gray seals were located at two sites in the eastern end of Nantucket Sound. Fifty-four percent of the seasonal count was on Muskeget Island and adjacent sand bars in Nantucket Sound, and 39% was on Monomoy Island. Recently, a small number of gray seals have maintained a winter presence in the Woods Hole region (Vineyard Sound) (deHart 2002).

Table 1. Summary of abundance estimates for the western North Atlantic gray seal. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	N_{min}[1]	CV
~~Apr-May 1994~~	~~Muskeget Island and Monomoy, MA~~	~~2,010~~	~~none reported~~
Spring 1999	Muskeget Island and Monomoy, MA	5,611	none reported
May 2001	Maine coast	1,600	none reported
1999 + 2001	Muskeget Is, Monomoy, and Maine	7,200	none reported

[1] These counts pertain to animals seen in USA waters, and the stock relationship to animals in Canadian waters is unknown.

Minimum Population Estimate

At the November 1998 meeting of the Atlantic Scientific Review Group (ASRG), the ASRG recommended that the minimum estimate (2,010) used in previous assessments be discontinued, because it can not be determined what part of the mortality comes from the Massachusetts, Maine, and Sable Island portions of the population. Therefore, present data are insufficient to calculate the minimum population estimate for USA waters. It is estimated that there are at least 143,000 gray seals in Canada (Mohn and Bowen 1996).

Current Population Trend

Gray seal abundance is likely increasing in the USA Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown. The population in eastern Canada was greatly reduced by hunting and bounty programs, and in the 1950's the gray seal was considered rare (Lesage and Hammill 2001). The Sable Island population was less affected and has been increasing for several decades ~~in Canadian waters~~. Pup production on Sable Island, Nova Scotia, has been about 13% per year since 1962 (Stobo and Zwanenberg 1990; Mohn and Bowen 1996); whereas, in the Gulf of St. Lawrence it is increasing at a slower rate of 7.4% per year (Hammill *et al.* 1998). Approximately 57% of the western North Atlantic population is from the Sable Island stock. In recent years pupping has been established on Hay Island, off the Cape Breton coast (Lesage and Hammill 2001).

Winter breeding colonies in Maine and on Muskeget Island may provide some measure of gray seal population trends and expansion in distribution. Sightings in New England increased during the 1980s as the gray seal population and range expanded in eastern Canada. Five pups were born at Muskeget in 1988. The number of pups increased to 12 in 1992, 30 in 1993, and 59 in 1994 (Rough 1995). Gray seal pups were recorded on three flight days during the 1998/1999 winter surveys (26 January, 9 February, and 10 March). On 9 February, 77 gray seal pups (59 on Muskeget Island and 18 on South Monomoy) were recorded (Barlas 1999). The 1999 NMFS flights only surveyed the Muskeget shoreline and are believed to be negatively biased, since recent anecdotal information suggests that peak pupping occurs by mid-January. ~~Further, naturalists conducting seal watch trips to Muskeget, and aerial surveys conducted by V. Rough (deceased) suggests hundreds of gray seal pups were born in 2000.~~ In January 2002, between 467-1,023 pups were counted on Muskeget Island and surrounding shoals (S. Wood, pers. comm., University of Massachusetts, Boston, MA). These observations continue the increasing trend in pup production reported by Rough (1995). NMFS recently initiated a collaborative program with the University of Massachusetts, Boston and University of Maine, Orono to monitor gray seal population trends and pup production in New England waters. The change in gray seal counts at Muskeget and Monomoy from 2,010 in 1994 to 5,611 in 1999 represents an annual increase rate of 20.5%, however, it can not be determined what proportion of the increase represents growth or immigration.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. One study that estimated pup production on Sable Island estimated an annual or net productivity increase in pup numbers of ~~production rate was~~ 13% (Mohn and Bowen 1994).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is 1.0, the value for stocks of unknown status, but is known to be increasing. PBR for the western North Atlantic gray seals in USA waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~1996-2000~~1997-2001, the total estimated human caused mortality and serious injury to gray seals is estimated to be ~~307~~309 per year. The average is derived from three components: 1) ~~118~~131 (~~CV=0.35~~CV=0.26; Table 2) from the ~~1996-2000~~1997-2001 USA observed fishery; 2) ~~4.5~~4.6 from ~~average 1997-2000~~average 1997-2001 stranding mortalities in USA waters resulting from power plant entrainments, oil spill, shooting, and other sources, and 3) ~~184~~173 from average ~~1996-2000~~1997-2001 kill in the Canadian hunt (Anon. 2001).

Fishery Information

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Northeast Multispecies Sink Gillnet

In 1993, there were approximately 349 full and part-time vessels in the Northeast multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden 1996) and their fishing effort was not used in estimating mortality. In 1998, there were approximately 301 vessels in this fishery (NMFS unpublished data). Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 6%, and ~~6%~~4% for 1990- ~~2000~~2001, respectively. The fishery has been observed in the Gulf of Maine and in southern New England. There were ~~45~~47 gray seal mortalities observed in the Northeast multispecies sink gillnet fishery between ~~1993-2000~~1993 and 2001. Twenty-one of the observed mortalities occurred in winter (January - May), 9 in the southern Gulf of Maine, 2 in the "mid-coast closed area", and 2 in the South Cape closure. Only 1 mortality was observed in northern Maine waters, which occurred in autumn (September-December) 1995. One of the 1993 observed mortalities was in May and was from SE of Block Island. ~~Seasonality of takes needs to be updated.~~Both observed mortalities in 2001 were during the summer (June-Aug).

Annual estimates of gray seal bycatch in the Northeast multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery ~~during 1990-1996~~ was 0 in 1990-1992, 18 in 1993 (1.00), 19 in 1994 (0.95), 117 in 1995 (0.42), 49 in 1996 (0.49), 131 in 1997 (0.50), 61 in 1998 (0.98), 155 in 1999 (0.51), ~~and~~ 193 in 2000 (.55), and 117 in 2001 (.59). The 1995 bycatch includes 28 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of bycatch of harbor seals, gray seals, harp seals, and hooded seals. ~~Further, they will likely have little impact on the estimates presented. Average annual estimated fishery-related mortality and serious injury to this~~

~~stock attributable to this fishery during 1996-2000 was 118 gray~~ Since 1997, unidentified seals ~~(CV=0.35)~~have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. There were 0, 1, 5, and 8 unidentified seals observed during 1998 through 2001, respectively. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1997-2001 was 131 gray seals (CV=0.26). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

Mid-Atlantic Coastal Gillnet

Observer coverage of the USA Atlantic coastal gillnet fishery was initiated by the NEFSC Sea Sampling program in July 1993; and from July to December 1993, 20 trips were observed. During 1994 and 1995, 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized. Observer coverage, expressed as percent of tons of fish landed, was 5%, 4%, 3%, 5%, 2%, 2%, and 2% for 1995, 1996, 1997, 1998, 1999, and 2000, and 2001, respectively (Table 2).

No gray seals were taken in observed trips during 1995-2000. One gray seal was observed taken during a "fish trip" (not "marine mammal trip") in 2001 (Table 2). The gray seal was taken at 44 fathom depth during the month of April off the coast of New Jersey near Hudson Canyon. Observed effort was scattered between Delaware and North Carolina from 1 to 50 miles off the beach. The annual (2001) and mean mortality was not estimated (Table 2).

CANADA

An unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994). In addition to incidental catches, some mortalities (e.g., seals trapped in herring weirs) were the result of direct shooting, and there were culls of about 1,700 animals annually during the 1970's and early 1980's on Sable Island (Anon. 1986).

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

Herring weirs are also distributed throughout the Bay of Fundy; and, it has been reported that 180 weirs were operating in the Bay of Fundy in 1990 (Read 1994).

In 1996, observers recorded 3 gray seals (1 released alive) in Spanish deep-water trawl fishing on the southern edge of the Grand Banks (NAFO Areas 3) (Lens, 1997). Seal bycatches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 2. Summary of the incidental mortality of gray seal (*Halichoerus grypus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type[1]	Observer Coverage[2]	Observed Mortality[3]	Estimated Mortality[3]	Estimated CVs	Mean Annual Mortality
Northeast Multispecies Sink Gillnet[3]	~~96-00~~ 97-01	301	Obs. Data Weighout, Logbooks	~~.04,~~ .06, .05, .06, .06, .04	~~3,~~ 16, 4, 5, 5, 2	~~49,~~ 131, 61, 155, 193, 117	~~.49,~~ .50, .98, .51, .55, .59	~~118~~ 131 ~~(.35)~~ (.26)
Mid-Atlantic Coastal Gillnet[4]	97-01	Unk[4 5]	Obs. Data Weighout	.03, .05, .02, .02, .02	0, 0, 0, 0, 1	0, 0, 0, 0, ~~NA~~ 0	0, 0, 0, 0, ~~NA~~ 0	~~1~~ 0 (~~NA~~0.00)
TOTAL								~~118~~ ~~132~~ 131 ~~(.35)~~(.26)

[1] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.

[2] The observer coverage for the Northeast multispecies sink gillnet fishery is measured in trips. Observer coverage of the mid-Atlantic coastal gillnet fisheries are measured in tons of fish landed.

[3] In ~~1995,~~ 1998 ~~and~~, 2000, and 2001 respectively, observed mortality on " marine mammal trips" was ~~6,~~3, 3, and 2 animals. In 1997 and 1999 all observed takes were on marine mammal trips. In 1998 ~~had 1 mortality in each year and in~~, 2000, and 2001 there was 1, 2, and 1 mortalities ~~were~~ recorded on " fish trips". Only ~~these~~ mortalities observed on " marine mammal trips" ~~were~~ are used to estimate ~~total gray seal~~ bycatch. See Bisack (1997) for " trip" type definitions. ~~1995 and In 1997 all The one observed takes were take in the mid-Atlantic gillnet fisheries (2001) was on a " fish marine mammal trips trip", including 12 taken on pingered therefore no mortality estimate was extrapolated.~~ Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure ~~that did not required pingers~~ were pooled ~~with the takes from nets with and without pingers,~~ respectively, ~~from the same stratum~~. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 1998, 1 take was observed in a net without a pinger that was within a marine mammal closure that required pingers. In 1997, 1999 and 2000, respectively, 12, 2 and 2 takes were observed ~~each year~~ in nets with pingers. In 2001 no gray seals were observed taken in nets equipped with pingers.

[4] The one observed take in the mid-Atlantic gillnet fisheries (2001) was on a " fish trip", therefore no mortality estimate was extrapolated. See Bisack (1997) for " trip" type definitions.

~~4~~[5] Number of vessels is not known.

Other Mortality

Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960's. This hunt may have severely depleted this stock in USA waters (Rough 1995). In addition, the Cape Cod stranding network has documented several animals with netting or plastic debris around their necks in the Cape

Cod/Nantucket area. An unknown level of mortality also occurs in the mariculture industry (*i.e.*, salmon farming) and by deliberate shooting (NMFS unpublished data).

In Canada, gray seals were hunted for several centuries by indigenous people and European settlers in the Gulf of St. Lawrence and along the Nova Scotia eastern shore, and were locally extirpated (Lavigueur and Hammill 1993). By the mid-1900s gray seals were considered to be rare, and in the mid-1960s the population in eastern Canada was estimated to be 5,600 (Mansfield 1966). Since the mid-1960s the population has been increasing. During a bounty program (1976-1983) and a culling program (1967-1983), the average annual removals were 720 and 1,000 seals, respectively (Anon 2001). Between 1993-2000, the annual kill of gray seals by hunters was: 1993 (0), 1994 (40), 1995 (364), 1996 (132), 1997 (72), 1998 (275), 1999 (98), and 2000 (342) (Anon 2001). The traditional hunt of a few hundred animals is expected to continue in 2001 (Anon 2001) off the Magdalen Islands and in other areas, except Sable Island, where commercial hunting is not permitted.

~~The 1992-1996 gray seal strandings data are currently under review~~Canada also issues personal hunting licenses, which allows the holder to take 6 grey seals annually (Lesage and Hammill 2001). Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill 2001).

From ~~1997-2000~~1997 to 2001, ~~133~~197 gray seal strandings were recorded, extending from Maine (~~19~~25) to North Carolina (1). Most of the strandings were in Massachusetts (~~48~~72), New York (~~31~~55), and Maine (~~19~~25). ~~Eighteen~~Twenty-three animals showed signs of human interactions: fishery (~~6~~8), power plant (3), oil spill (~~4~~6), shot (1), mutilated (1), boat strike (1) and other (3). ~~Further, many live strandings are euthanized due to the animal's condition.~~ ~~Some~~Further, some live strandings are euthanized due to the animal's condition, and some sick and injured seals are transported to rehabilitation facilities. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured wash ashore, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction.

STATUS OF STOCK

The status of the gray seal population, relative to OSP, in US Atlantic EEZ waters is unknown, but the populations appear to be increasing in Canadian and USA waters. The species is not listed as threatened or endangered under the Endangered Species Act. Recent data indicate that this population is increasing. The total fishery-related mortality and serious injury for this stock is believed to be very low relative to the population size in Canadian waters and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the US Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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~~January~~December 2002

HARP SEAL (*Phoca groenlandica*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988); however, in recent years, numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Katona *et al*. 1993; Stevick and Fernald 1998; B. Rubinstein, pers. comm., New England Aquarium; McAlpine 1999; Lacoste and Stenson 2000). These extralimital appearances usually occur in January-May (Harris *et al*. 2002), when the western North Atlantic stock of harp seals is at its most southern point of migration. Concomitantly, a southward shift in winter distribution off Newfoundland was observed during the mid-1990s, which was attributed to abnormal environmental conditions (Lacoste and Stenson 2000). The world's harp seal population is divided into three separate stocks, each identified with a specific breeding site (Bonner 1990; Lavigne and Kovacs 1988). The largest stock is located in the western North Atlantic off eastern Canada and is divided into two breeding herds which breed on the pack ice. The Front herd breeds off the coast of Newfoundland and Labrador, and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). The second stock breeds in the White Sea off the coast of the Soviet Union, and the third stock breeds on the West Ice off eastern Greenland (Lavigne and Kovacs 1988; Anon 1998). Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between mid-February and April ~~for each stock~~. Adults then assemble north of their whelping patches to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. ~~Following mating, the seals disperse to feed, and in late April they again concentrate in large numbers on the ice to molt.~~

The extreme southern limit of the harp seal's habitat extends into the USA Atlantic Exclusive Economic Zone (EEZ) during winter and spring. Support for the increase in numbers and geographic distribution of harp seals in New England to mid-Atlantic waters is based primarily on strandings, and secondarily on fishery bycatch (McAlpine and Walker 1990; Rubinstein 1994).

POPULATION SIZE

The total population size of harp seals is unknown; however, three seasonal abundance estimates are available which use a variety of methods including aerial surveys and mark-recapture (Table 1). Generally, these methods include surveying the whelping concentrations and modeling pup production. Harp seal pup production in the 1950s was estimated at 645,000 decreasing to 225,000 by 1970 (Sergeant 1975). Estimates began to increase at that time and have continued to rise, reaching 478,000 in 1979 (Bowen and Sergeant 1983; Bowen and Sergeant 1985), 577,900 in 1990 (Stenson *et al*. 1993), and 998,000 in 1999 (Stenson *et al*. 2000).

Roff and Bowen (1983) developed an estimation model to provide a more precise estimate of total ~~population~~ abundance. This technique incorporates recent pregnancy rates and estimates of age-specific hunting mortality (CAFSAC 1992). Shelton *et al*. (1992) applied a harp seal estimation model to the 1990 pup production and obtained an estimate of 3.1 million (range 2.7-3.5 million; Stenson 1993). Using a revised population model, 1994 pup count data, and two assumptions regarding pup mortality rates, Shelton *et al*. (1996) estimated pup production and total population size for the period 1955-1994. The 1994 total population estimate was 4.8 million (95% CI = 4.1 - 5.5 million) harp seals (Warren *et al*. 1997~~; Table1~~). The 1999 population estimate was 5.2 million (95% CI = 4.0 - 6.4 million) harp seals (Healey and Stenson 2000) (Table 1).

Table 1. Summary of abundance estimates (pups and total) for western North Atlantic harp seals. Year and area covered during each abundance survey, resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	~~N_{min}~~ N_{best}	CV
~~1994~~	~~Eastern Atlantic Canada-Labrador~~	~~702,900 pups~~	~~0.09~~
~~1994~~	~~Eastern Atlantic Canada-Labrador~~	~~4.8 million~~	~~±772,000[+]~~
1999	Eastern Atlantic Canada - Labrador	998,000 pups	±200,000 (95% CI)
1999	Eastern Atlantic Canada - Labrador	5.2 million	±1,200,000 (95% CI)

~~[+] Original confidence intervals provided by Shelton *et al.* (1996) were skewed and recalculated by Warren *et al.* (1997).~~

Minimum population estimate

Present data are insufficient to calculate the minimum population estimate for USA waters. It is estimated there are at least 5.2 million (±1.2 million) harp seals in Canada (Healey and Stenson 2000).

Current population trend

The population appears to be increasing in USA waters, judging from the increased number of stranded harp seals, but the magnitude of the suspected increase is unknown. In Canada, since 1996 the population has been stable (5.2 million; ±1.2 million) due to large harvests of young animals in recent years (Healey and Stenson 2000).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The best data are based on Canadian studies. Recent studies indicate that pup production has increased, but the rate of population increase cannot be quantified at this time (Stenson *et al.* 1996). The mean age of sexual maturity was 5.8 yrs in the mid-1950's, declining to 4.6 yrs in the early 1980's and then increasing to 5.6 yrs in the mid-1990s (Sjare *et al.* 1996; Sjare and Stenson 2000).

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size in USA waters is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 1.0 because it was believed that harp seals are within OSP. PBR for the western North Atlantic harp seal in USA waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of 312,000 harp seals. However, Johnston *et al.* (2000) suggests that catch statistics from the Canadian hunt are negatively biased due to under reporting; therefore, an F_R of 0.5 ~~would~~ may be appropriate. Using the lower F_R results in a "PBR" of 156,000 harp seals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~1996-2000~~1997-2001, the total estimated human caused mortality and serious injury to harp seals was ~~321,222~~287,949. This is derived from ~~three~~ four components: 1) ~~301,611~~268,337 from ~~1996-2000~~1997 to 2001 (1997=333,873; 1998=365,115; 1999=324,606; 2000=91,602 and 2001= 226,493) average catches of Northwest Atlantic harp seals by Canada and Greenland; 2) 16,000 - 23,000 (annually) from average bycatches in the

Newfoundland lumpfish fishery; ~~and~~ 3) ~~111~~109 harp seals ~~CV=0.29~~CV=0.31 from the observed USA fisheries (Table 2), and 4) 3 from average 1997 to 2001 stranding mortalities showing signs of human interaction.

Fishery Information

USA

Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fisheries information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Recent bycatch has been observed by NMFS Sea Samplers in the Northeast multispecies sink gillnet fisheries, but no mortalities have been documented in the mid-Atlantic coastal gillnet, Atlantic drift gillnet, pelagic pair trawl or pelagic longline fisheries.

Northeast Multispecies Sink Gillnet:

In 1993, there were approximately 349 full and part-time vessels in the Northeast multispecies sink gillnet fishery which covered the Gulf of Maine and southern New England (Table 2). An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden 1996) and their fishing effort was not used in estimating mortality. In 1998, there were approximately 310 vessels in this fishery (NMFS unpublished data). Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6% 6%, and ~~6%~~4% for 1990 to ~~2000~~2001, respectively. The fishery has been observed in the Gulf of Maine and in Southern New England. There were ~~121~~ 122 harp seal mortalities observed in the Northeast multispecies sink gillnet fishery between 1990 ~~and 2000~~and 2001. Annual estimates of harp seal bycatch in the Northeast multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery during ~~1990-1999~~1990-2001 were 0 during 1990-1993, 861 in 1994 (0.58), 694 in 1995 (0.27), 89 in 1996 (0.55), 269 in 1997 (0.50), 78 in 1998 (0.48), 81 in 1999 (0.78), ~~and~~ 24 in 2000 (1.57) and 26 in 2001 (1.04). The 1994 and 1995 bycatches include 16 and 153 animals, respectively, from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of bycatch of harbor seals, gray seals, harp seals, and hooded seals. ~~Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1996-2000 was 108 harp~~ Since 1997, unidentified seals ~~(CV=0.30)~~have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. There were 0, 1, 5, and 8 unidentified seals observed during 1998 through 2001, respectively. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 1997-2001 was 96 harp seals (CV=0.33). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The bycatch occurred principally in winter (January-May) and was mainly in waters between Cape Ann and New Hampshire. One observed winter mortality was in waters south of Cape Cod.

Mid-Atlantic Coastal Gillnet:

Observer coverage of the USA Atlantic coastal gillnet fishery was initiated by the NEFSC Sea Sampling program in July 1993 and, from July to December 1993, 20 trips were observed. During 1994 and 1995, 221 and 382 trips were observed, respectively. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown because records which are held by both state and federal agencies have not been centralized and standardized. Observer coverage, expressed as percent of tons of fish landed, was 5%, 4%, 3%, 5%, 2%, 2%, and 2% for 1995, 1996, 1997, 1998, 1999, ~~and~~ 2000, and 2001, respectively (Table 2).

No harp seals were taken in observed trips during 1993-1997, and ~~1999~~1999-2001. One harp seal was observed taken in 1998 (Table 2). Observed effort was ~~concentrated off NJ and~~ scattered between ~~DE~~New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997, 17 in 1998 (1.02), and 0 in ~~both 1999 and 2000~~1999-2001. Average annual estimated fishery-related mortality attributable to this fishery during ~~1996-2000~~1997-2001 was 3.0 harp seals (CV=1.02).

~~CANADA~~

~~An unknown number of harp seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994).~~

North Atlantic Bottom Trawl

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management needs, rather than marine mammal management needs. An average of 970 vessels (full and part time) participated annually in the fishery during 1991-1995. The fishery is active in all seasons in New England waters. No mortalities were observed between 1991-2000 and one mortality was observed in 2001. Observer coverage, expressed as number of trips, was < 1% from 1997 to 2001 (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0 between 1991-2000, and 49 (CV=1.10) in 2001. Average annual estimated fishery-related mortality attributable to this fishery in 2001 was 10 harp seals (CV=1.10) (Table 2). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage.

CANADA

An unknown number of harp seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994). Harp seals are being taken in Canadian lumpfish and groundfish gillnets and trawls, but estimates of total removals have not been calculated to date (Anon. 1994). A recent analysis of bycatch in the Newfoundland lumpfish fishery indicates that fewer than 10,000 seals were taken annually from the start of the fishery in 1968 until 1984 (Walsh et al. 2000). Between 1984 and 1995, annual bycatches have been more variable, ranging between 3,000 and 36,000 animals. Since 1996, bycatches have varied between 16,000 and 23,000 seals annually (DFO 2000).

There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.

In 1996, observers recorded 4 harp seals (1 released alive) in Spanish deep-water trawl fishing on the southern edge of the Grand Banks (NAFO Areas 3) (Lens 1997). Seal bycatches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

Table 2. Summary of the incidental mortality of harp seal (*Phoca groenlandica*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality[3]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Multispecies Sink Gillnet	~~96-00~~ 97-01	301	Obs. Data Weighout, Logbooks	~~.04,~~ .06, .05, .06, .06, .04	~~9,~~ 40, 4, 4, 3, 1	~~89,~~ 269, 78, 81, 24, 26	~~.55,~~ .50, .48, .78, 1.57, 1.04	~~108~~ 96 ~~(.30)~~ (.33)
Mid Atlantic Coastal Sink Gillnet	~~96-00~~ 97-01	Unk[4]	Obs. Data Weighout	~~.04,~~ .03, .05, .02, .02, .02	~~0,~~ 0, 1, 0, 0, 0	~~0,~~ 0,17, 0, 0, 0	~~0,~~ 0, 1.02, 0, 0, 0	3 (1.02)
North Atlantic Bottom Trawl	97-01	970	Obs. Data Weighout	.002, .001, .003, .003, .004	0, 0, 0, 0, 1	0, 0, 0, 0, 0, 49	0, 0, 0, 0, 1.10	10 (1.10)
TOTAL								~~111~~109 ~~(.29)~~ (.31)

[1] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects landings data (Weighout) and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.

[2] The observer coverage for the Northeast multispecies sink gillnet fishery is measured in trips. Observer coverage for the Mid Atlantic coastal sink gillnet fishery is measured in tons of fish landed. North Atlantic bottom trawl fishery coverage is measured in trips.

[3] In the New England sink gillnet fishery, 31 and 0 harp seals were taken on pingered trips during 1997 and 1998, respectively. During 1997, 1998, 1999, ~~and~~ 2000, and 2001, there were 31, 4, 2, ~~and~~ 2, and 1 harp seals observed on "mammal trips", respectively. See Bisack (1997) for "trip" type definitions. ~~During~~ Between 1999 and ~~2000~~,2001, 2, ~~and~~ 1, and 0 harp seals, respectively, were observed on "fish trips" and 3, ~~and~~ 2, and 1 were observed taken from pingered nets.

[4] Number of vessels is not known.

Other Mortality

Harp seals have been commercially hunted since the mid-1800's in the Canadian Atlantic (Stenson 1993). A total allowable catch (TAC) of 200,000 harp seals was set for the large vessel hunt in 1971. The TAC varied until 1982 when it was set at 186,000 seals and remained at this level through 1995 (Stenson 1993; Anon 1998). The TAC was increased to 250,000 and 275,000, respectively, in 1996 and 1997 (Anon 1998). The 1997 TAC has remained in effect through 2001 (Anon 2001a). In 2001, the Canadian Minister of Fisheries and Oceans established a panel of eminent persons to provide advice on a long-term strategy for the management of seal populations (Anon 2001). Catches ranged from 124,000 to 231,000 from 1971 to 1982, declined to a range of 19,000 to 94,000 between 1983 and 1995, and increased dramatically to 243,000 in 1996 and 282,000 in 1998 (Stenson 1993; Anon 1998; Anon 2001). Catches declined to 92,000 in 2000 (Anon 2001b). Harp seals are also hunted in the Canadian Arctic and in Greenland (DFO 2000). There are no recent statistics for the Canadian Arctic, but during the late 1970's annual catches ranged between 1,200 and 6,500 animals. Prior to 1980, Greenland

catches were fewer than 20,000 annually, but in recent years have dramatically increased to around 100,000 (DFO 2000). The commercial catches do not account for subsistence takes and animals that are killed but not landed (struck and lost) (Lavigne 1999). A recent analysis of the struck and lost rates suggests that the rate for young seals (majority of Canadian take) is less than 5%, while losses of older seals are higher (approximately 50%) (DFO 2000).

From 1988 to 1993 strandings each year were under 50, approaching 100 animals in 1994, and exceeding 100 animals in 1995-1996 (Rubinstein 1994; B. Rubinstein, New England Aquarium, pers. comm.). In addition, in 1996 there was a stranding in North Carolina. From ~~1997-2000~~1997 to 2001, ~~485~~980 strandings were recorded, ~~including one~~of which 50% (495) were in ~~North Carolina~~2001. ~~Most~~Fifty-two percent (n=258) of the 2001 strandings ~~occurred in Maine (73), Massachusetts (158), New York (166) and New Jersey (32)~~were carcasses, and the remaining 48% were live strandings. ~~Further, many are live strandings and some are euthanized due~~Strandings were recorded from Maine (166/17%) to North Carolina (1), and the ~~animal's condition~~ highest numbers were in Massachusetts (339/35%) and New York (277/28%). ~~Some sick~~Many were live strandings and ~~injured seals~~some were ~~transported~~euthanized due to ~~rehabilitation facilities~~the animal's condition. Some sick and injured seals were transported to rehabilitation facilities, and some subsequently died. Few harp seals showed signs of human interactions and, except for 4 shot animals, 8 fishery interactions, 1 mutilated animal, 1 boat strike, and 1 ingested plastic, the interactions were classified as other (e.g., no signs of human interaction). ~~Few animals showed signs of human interactions and~~Changes in environmental conditions, ~~except for 4 shot animals, 1 fishery interaction, and 1 mutilated animal, the interactions were classified~~collapse of fish stocks, and changes in the distribution of prey off Atlantic Canada have been suggested as ~~other~~causes of the southward and extralimital seasonal shift in harp seal distribution since the mid 1990's (McAlpine *et al*. 1999; Lacoste and Stenson 2000). ~~The increased number of~~Factors contributing to a dramatic increase in strandings in 2001 are unknown (Harris *et al*. 2002), but may indicate a possible shift in distribution or expansion southward into USA waters.

STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the US Atlantic EEZ is unknown, but the population appears not to be ~~stable~~ increasing in Canadian waters. ~~, due to harvest of young animals.~~ The species is not listed as threatened or endangered under the Endangered Species Act. The total fishery-related mortality and serious injury for this stock is believed to be very low relative to the population size in Canadian waters and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the USA Atlantic EEZ is ~~unknown, but~~ believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

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~~December 1998~~December 2002

HOODED SEAL (*Cystophora cristata*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The hooded seal occurs throughout much of the North Atlantic and Arctic Oceans (King 1983) preferring deeper water and occurring farther offshore than harp seals (Sergeant 1976; Campbell 1987; Lavigne and Kovacs 1988; Stenson *et al.* 1996). Hooded seals tend to wander far out of their range and have been seen as far south as Puerto Rico (Mignucci-Giannoni and Odell 2001), with increased occurrences from Maine to Florida. These appearances usually occur between January and May in New England waters, and in summer and autumn off the Southeast USA coast and in the Caribbean (McAlpine *et al.* 1999; Harris *et al.* 2001; Mignucci-Giannoni and Odell 2001). Although it is not known which stock these seals come from, it is known that during ~~this time frame~~spring, the Northwest Atlantic stock of hooded seals are at their southern most point of migration in the Gulf of St. Lawrence. The worlds' hooded seal population is divided into three separate stocks, each identified with a specific breeding site (Lavigne and Kovacs 1988; ~~In the northwest Atlantic, whelping occurs in the Davis Strait, off Newfoundland and in Gulf of St. Lawrence~~ Stenson *et al.* 1996). One stock, which whelps off the coast of eastern Canada, is divided into two breeding herds (Front and Gulf) which breed on the pack ice. The Front herd (largest) breeds off the coast of Newfoundland and Labrador and the Gulf herd breeds in the Gulf of St. Lawrence. The second stock breeds in the Davis Strait, and the third stock occurs on the West Ice off eastern Greenland.

Hooded seals are a highly migratory species. Hooded seals remain on the Newfoundland continental shelf during winter/spring (Stenson *et al.* 1996). Breeding occurs at about the same time in March for each stock. Adults from all stocks then assemble in the Denmark Strait to molt between late June and August (King 1983; Anon 1995), and following this, the seals disperse widely. Some move south and west around the southern tip of Greenland, and then north along the west coast of Greenland. Others move to the east and north between Greenland and Svalbard during late summer and early fall (Lavigne and Kovacs 1988). Little else is known about the activities of hooded seals during the rest of the year until they assemble again in February for breeding.

~~Hooded seals are rarely found in the U.S. Atlantic Exclusive Economic Zone. Small numbers of hooded seals at the extreme southern limit of their range occur in the winter and spring, and from the southeast seasons. The influx of harp seals and geographic distribution in New England to mid-Atlantic waters is based on stranding data.~~

POPULATION SIZE

The number of hooded seals in the western North Atlantic is unknown. Seasonal abundance estimates are available based on a variety of analytical methods based on commercial catch data, and including aerial surveys. These methods often include surveying the whelping concentrations and modeling the pup production. Several estimates of pup production at the Front are available. Hooded seal pup production between 1966 and 1977 was estimated ~~between~~ at 25,000 - 32,000 annually (Benjaminsen and Oritsland 1975; Sergeant ~~1976~~1976b; Lett 1977; Winters and Bergflodt 1978; Stenson *et al.* 1996). Estimated pup production dropped to 26,000 hooded seal pups in 1978 (Winters and Bergflodt 1978). Pup production estimates began to increase after 1978, reaching 62,000 (95% CI. 43,700 - 89,400) by 1984 (Bowen *et al.* 1987). Bowen *et al.* (1987) also estimated pup production in the Davis Strait at 18,600 (95% C.I. 14,000 - 23,000). A 1985 survey at the Front (Hay *et al.* 1985) produced an estimate of 61,400 (95% C.I. 16,500 - 119,450). Hammill *et al.* (1992) estimated pup production to be 82,000 (SE=12,636) in 1990. ~~No recent population estimate is available, but assuming~~Assuming a ratio of pups to total population of 1:5, pup production in the Gulf and Front herds would represent a total population of approximately 400,000-450,000 hooded seals (Stenson 1993). Based on the 1990 survey, Stenson *et al.* (1996) suggested that pup production may have increased at about 5% per year since 1984. However, because of exchange between the Front and the Davis Strait stocks, the possibility of a stable or slightly declining level of pup production is also likely (Stenson 1993; Stenson *et al.* 1996). ~~It appears that the number of hooded seals~~In 1998 and 1999, surveys were conducted to estimate pup production in the southern Gulf of St. Lawrence, which is ~~increasing~~the smallest component of the NW Atlantic stock (Anon. 2001a). The estimate of 2,000 was similar to the previous published

1990 estimate (Hammill *et al*. 1992; Anon. 2001a). The impact of the lack of ice in the Gulf in recent years on pup production is unknown (Anon. 2001). There are no current estimates of pup production for the Davis Strait or the Front breeding groups. The Joint ICES/NAFO Working Group on Harp and Hooded Seals recommended that new surveys be conducted to obtain a current assessment of the Northwest Atlantic stock (Anon. 2001a).

Table 1. Summary of pup production estimates for western North Atlantic hooded seals. Year and area covered during each abundance survey, and resulting abundance estimate (N_{min}) and coefficient of variation (CV).

Month/Year	Area	N_{min}	CV
1978	Front herd: Newfoundland/ Labrador	26,000	None reported
1984	Front herd: Newfoundland/Labrador	62,000	None reported
1984	Davis Strait	18,600	None reported
1985	Front herd: Newfoundland/Labrador	61,400	None reported
1990	Front herd: Newfound/Labrador	82,100	None reported

Minimum population estimate

Present data are insufficient to calculate the minimum population estimate for U.S. waters. It is estimated thatSince there are approximately 400,000 hooded seals (5:1 ratio of adultsno recent comprehensive pup production counts it is not possible to pups) in Canadian watersassess current population size (Stenson *et al.*Anon. 1993.2001a).

Current population trend

There are no current data to assess the status of the population in either Canadian or USA waters.Current population trend

The population appears to be increasing in U.S. Atlantic EEZ, judging from stranding records, although the actual magnitude of this increase is unknown. The Canadian population appears to be increasing but, because different methods have been used over time to estimate population size, the magnitude of this increase has not been quantified.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The most appropriate data are based on Canadian studies. Pup production in Canada may be increasing slowly (5% per annum), but due to the wide confidence intervals and lack of understanding regarding stock dynamics, it is possible thatThe most recent comprehensive pup production is stable or declining (Stenson 1993)survey (1990) is nearly 13 years old, which exceeds the GAMMS (Wade and Angliss 1997) criterion (e.g., >8 years) for reliable abundance data.

For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a " recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recover factor (F_R) for this stock is 1.0,0.5, the value for stocks with unknown population status, but know to be increasing. PBR for the western North Atlantic hooded seal in U.S. waters is unknown.
Applying the formula to abundance estimates (400,000) in Canadian waters results in a PBR= 24,000 hooded seals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~In Atlantic Canada~~For the period 1997 to 2001, ~~hooded seals have been commercially hunted at the Front since the late 1800's~~the total estimated human caused mortality and serious injury to hooded seals was 10,393. This is derived from two components: 1) 10,377 from 1997-2001 (1997=14,558; 1998=16,476; 1999[1]= 7,287; 2000[2]= 6,717; and 2001[2]= 6,847) average catches of Northwest Atlantic population of hooded seals by Canada and Greenland; and 2) 16 hooded seals (CV=1.14) from the observed USA fisheries (Table 2).

[1] 1999 Greenland catches are provisional; [2] 1998-1999 average Greenland catches

In 1974 total allowable catch (TAC) was set at 15,000, and reduced to 12,000 in 1983 and to 2,340 in 1984 (Stenson 1993; Anon 1998). From 1991- 1992 the TAC was increased to 15,000. A TAC of 8,000 was set for 1993, and held at that level through 1997. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,425 in 1991, with a mean catch of 1,001 between 1983 and 1995. In 1996 catches (25,754) were more than three times the allowable quota (Anon 1998). The high catch was attributable to good ice conditions and strong market demand. Catches in 1997 were 7,058, slightly below the TAC.

Hunting in the Gulf of St. Lawrence (below 50^0N) has been prohibited since 1964. No commercial hunting of hooded seals is permitted in the Davis Strait.

Total annual estimated average fishery-related mortality or serious injury to this stock in U.S. waters during 1992-1996 was 5.6 hooded seals (CV = 0.96; Table 2).

Fishery Information

USA

~~Data on current incidental takes in U.S.~~ Data on current incidental takes in USA fisheries are available from several sources. In 1986, NMFS established a mandatory self-reported fishery information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Sea Sampling Observer Program was initiated in 1989, and since that year several fisheries have been covered by the program. In late 1992 and in 1993, the SEFSC provided observer coverage of pelagic longline vessels fishing off the Grand Banks (Tail of the Banks) and provides observer coverage of vessels fishing south of Cape Hatteras.

Recent by-catch has been observed by NMFS Sea Samplers in the New England multispecies sink gillnet fisheries, but no mortalities have been documented in the mid-Atlantic coastal gillnet, Atlantic drift gillnet, pelagic pair trawl or pelagic longline fisheries.

In 1993, there were approximately 349 full- and part-time vessels in the New England multispecies sink gillnet fishery, which covered the Gulf of Maine and southern New England (Table 2). An additional 187 vessels were reported to occasionally fish in the Gulf of Maine with gillnets for bait or personal use; however, these vessels were not covered by the observer program (Walden 1996) and their fishing effort was not used in estimating mortality. Observer coverage in terms of trips has been 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6% and 4% for 1990 to ~~1996~~2001, respectively. The fishery has been observed in the Gulf of Maine and in southern New England. There ~~was one~~were 2 hooded seal mortalities observed in the New England multispecies sink gillnet fishery between 1990 and ~~1996~~2001. Annual estimates of hooded seal by-catch in the New England multispecies sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. Estimated annual mortalities (CV in parentheses) from this fishery during ~~1990-1996~~1990-2001 was 0 in 1990-1994, 28 in 1995 (0.96), ~~and~~ 0 in ~~1996~~1996-2000 and 82 in 2001 (1.14). The 1995 by-catch includes 5 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of by-catch of harbor seals, gray seals, harp seals, and hooded seals. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. There were 0, 1, 5 and 8 unidentified seals observed during 1998 through 2001, respectively. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~1992-1996~~1992-2001 was ~~5.6~~16 hooded seals (CV = ~~0.96~~1.14). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The by-catch ~~occurred only~~in 1995 occurred in winter (January-May), and the 2001 bycatch occurred in summer (July-September). All ~~and~~bycatch was in waters between Cape Ann and New Hampshire.

CANADA

An unknown number of hooded seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994).

~~There were 3,121 cod traps operating in Newfoundland and Labrador during 1979, and about 7,500 in 1980 (Read 1994). This fishery was closed at the end of 1993 due to collapse of Canadian groundfish resources.~~

Hooded seals are being taken in Canadian lumpfish and groundfish gillnets and trawls; however, estimates of total removals have not been calculated to date.

Table 2. Summary of the incidental mortality of hooded seal (*Cystophora cristata*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [1]	Observer Coverage [2]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Multispecies Sink Gillnet	~~92-96~~ 97-01	1993=349 1998=301	Obs. Data Weighout, Logbooks	~~.07, .05, .07, .05, .04~~ .06, .05, .06, .06, .04	~~0, 0, 0, 1, 0~~ 0, 0, 0, 0, 1	~~0, 0, 0, 28, 0~~ 0, 0, 0, 0, 82	~~0, 0, 0, .96, 0~~ 0, 0, 0, 0, 1.14	~~5.6 (.96)~~ 16 (1.14)
TOTAL								~~5.6 (.96)~~ 16 (1.14)

[1] Observer data (Obs. Data) are used to measure by-catch rates, and the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. NEFSC collects Weighout (Weighout) landings data, and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of some fishing effort in the New England multispecies sink gillnet fishery.

[2] The observer coverage for the New England multispecies sink gillnet fishery is measured in trips.

[3] Only mortalities observed on marine mammal trips were used to estimate total harbor seal bycatch. See Bisack (1997) for "trip" type definitions. The one hooded seal mortality observed in 2001 was taken in a net equipped with pingers.

Other Mortality

In ~~1988-93~~ Atlantic Canada, ~~strandings were less than 20 per year, and from 1994-1996 they increased to about 50 per annum (Rubinstein 1994; Rubinstein, pers~~ hooded seals have been commercially hunted at the Front since the late 1800's. In 1974 total allowable catch (TAC) was set at 15,000, and reduced to 12,000 in 1983 and to 2,340 in 1984 (Stenson 1993; Anon 1998). From 1991 to 1992 the TAC was increased to 15,000. A TAC of 8,000 was set for 1993, and held at that level through 1997. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,425 in 1991, with a mean catch of 1,001 between 1983 and 1995. In 1996 catches (25,754) were more than three times the allowable quota (Anon 1998). The high catch was attributable to good ice conditions and strong market demand. The TAC has remained at 10,000 since 1998 but catches have been very low (e.g., 10 seals in 2000; Anon. 2001b). Greenland catches remained below 5,000 during the period 1954-1975, but increased to 5,000 - 7,000 and 6,300 - 9,900, respectively, during the periods 1976-1992 and 1993-1998 (Anon. 2001a). A series of management regulations have been

implemented since 1960. For example, hunting in the Gulf of St. Lawrence (below 50^{0}N) has been prohibited since 1965, no commercial hunting of hooded seals is permitted in the Davis Strait, and in 2000, the taking of bluebacks was prohibited (Anon. 2001a).

In 1988-1993, strandings were fewer than 20 per year, and from 1994 to 1996 they increased to about 50 per year (Rubinstein 1994; Rubinstein, pers. comm). ~~Carcasses were recovered from Massachusetts~~From 1997 to 2001, ~~Connecticut, and New York (Rubinstein 1994~~1997=41; 1998=108; 1999=36; 2000=30, and 2001=86), ~~North Carolina and U.S.~~301 hooded seal strandings were reported to NOAA Fisheries Northeast Region Stranding Program. Strandings were recorded from Maine to Virginia, and highest numbers were in Maine (101/36%), Massachusetts (92/31%), New York (53/18%), and New Jersey (27/9%). Extralimital strandings have also been reported off the southeast USA, North Carolina to Florida, and in the Caribbean (McAlpine *et al*. ~~Virgin Islands (~~1999; Mignucci-Giannoni and Odell 2001; NMFS, unpubl. data). ~~The increased number of~~Many were live strandings ~~may indicate a possible shift in distribution or range expansion southward into U.S~~and some were euthanized due to the animal's condition. Some sick and injured seals were transported to rehabilitation facilities, and some subsequently died. Few hooded seals showed signs of human interactions. The increased number of strandings since the early 1990's may indicate a possible seasonal shift in distribution or range expansion southward into U.S. waters; if so, fishery interactions may increase.

STATUS OF STOCK

The status of hooded seals relative to OSP in U.S. Atlantic EEZ is unknown, but the population appears to be increasing in Canada. They are not listed as threatened or endangered under the Endangered Species Act. The total fishery-related mortality and serious injury for this stock is believed to be very low relative to the population size in Canadian waters and can be considered insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because the level of human-caused mortality and serious injury is believed to be very low relative to overall stock size.

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